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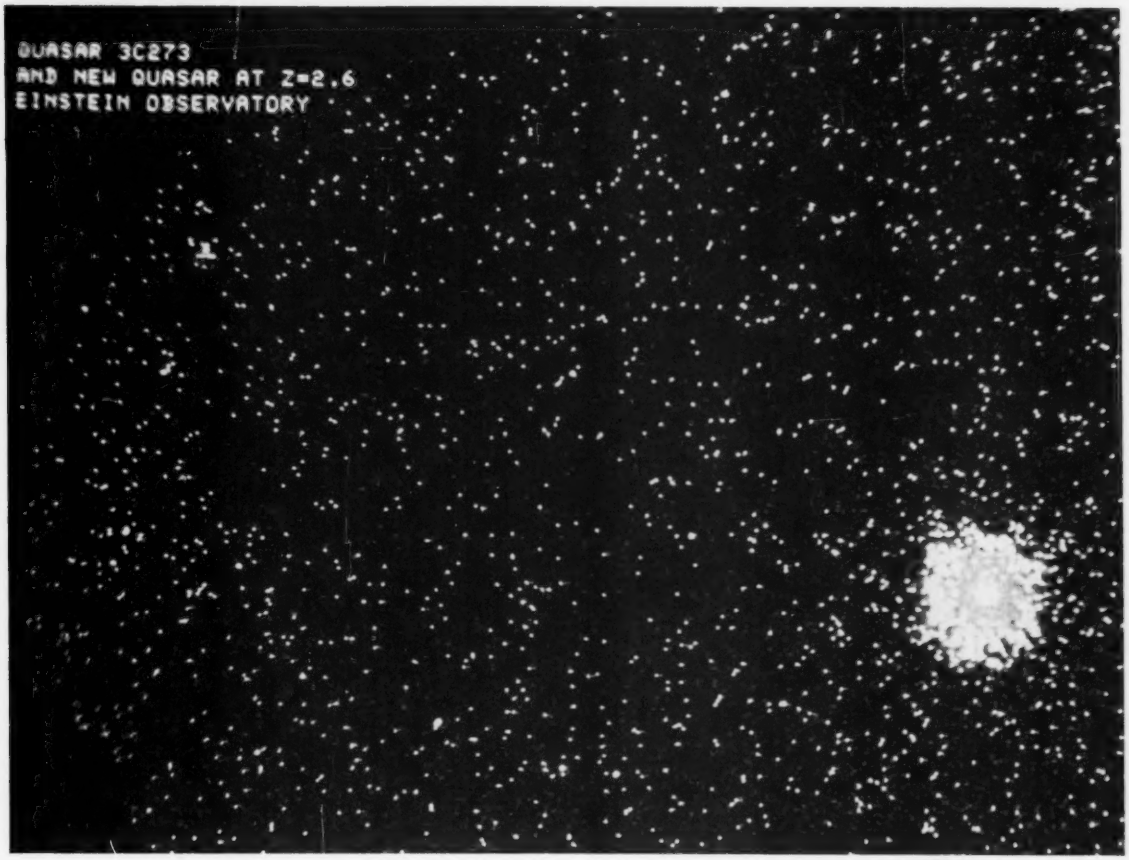


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## Cover

**At the Very Edge of the Universe**—This X-ray picture, taken by NASA's High Energy Astronomy Observatory 8 (HEAO-2) reveals a newly discovered object (upper left), which appears to be the most distant and brightest quasar yet observed to emit X-rays. The large bright object at lower right of photo is quasar 2C273, an object familiar to astronomers since its discovery a decade and a half ago. Of 20 known quasars observed by HEAO, only three did not have strong X-ray radiation, indicating that they are objects of incredibly high energy.

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# Letter from Washington

Dear Colleagues:

The President has proclaimed May 28-June 3, 1979, to be Vietnam Veterans' Week, and he has asked that all agencies of the federal government become involved in this national salute to Vietnam veterans. This is a most worthwhile effort and one which I endorse most heartily.

The goal of the week of tribute is "To ensure that the Nation expresses its gratitude to the veterans of the Vietnam conflict for their service, sacrifice and patriotism by honoring them and recognizing their contributions to the society."

The language used by the Congress in the Joint Resolution that authorizes and requests the President to set aside this special week further defines the reasons for the measure:

". . . [they] performed such service under the most trying conditions because of the lack of domestic support for the conflict and because of the nature of the conflict itself; . . . [that] the battlefield performance of America's soldiers, sailors, marines, and airmen during the Vietnam conflict was by all measures the equal of that of their counterparts in previous conflicts; . . . [that] an adverse image has often been unfairly attached to the Vietnam veteran as an individual because of the controversial nature of the Vietnam conflict; and . . . the Nation has never fully expressed its gratitude to those who gave a substantial portion of their lives at their Government's request and in the name of the people of the United States to serve in such conflict."

I am confident that all NASA employees will join with me in saluting the great sacrifice and contribution these individuals made during the Vietnam conflict. Our gratitude and thanks are extended to all these veterans and particularly to the many who have become part of the NASA community.

Robert A. Frosch

## KSC Gears Up for the Big Event

To the cheers of more than 3,000 visitors, the Space Shuttle orbiter *Columbia,* perched atop its 747 Shuttle carrier aircraft, touched down on the 4,650-meter-long runway at the Kennedy Space Center on March 24, ending a 1,126-kilometer trip from California.

All eyes were on the sky as the pair appeared suddenly out of the distance in a clear blue sky. Gliding effortlessly along-Florida's eastern shoreline, the 747 flew over the many launch pads reminiscent of man's first journey into space, and past the massive vehicle assembly building where—later this year—*Columbia,* the first of NASA's new breed of reusable spaceships, will be made ready for launch.

The carrier plane's pilots, Fitzhugh Fulton and Joseph Algranti, then took the jumbo jet on a wide circle that carried it over the nearby community of Titusville, delighting the thousands of visitors from all over the country who stood along the Indian River bank to catch a glimpse of the unlikely pair before the 747 made its final approach.

At 11:03 a.m., descending into a gusting westerly wind, the 747 and *Columbia* lightly touched the runway, sending smoke spewing from the tires.

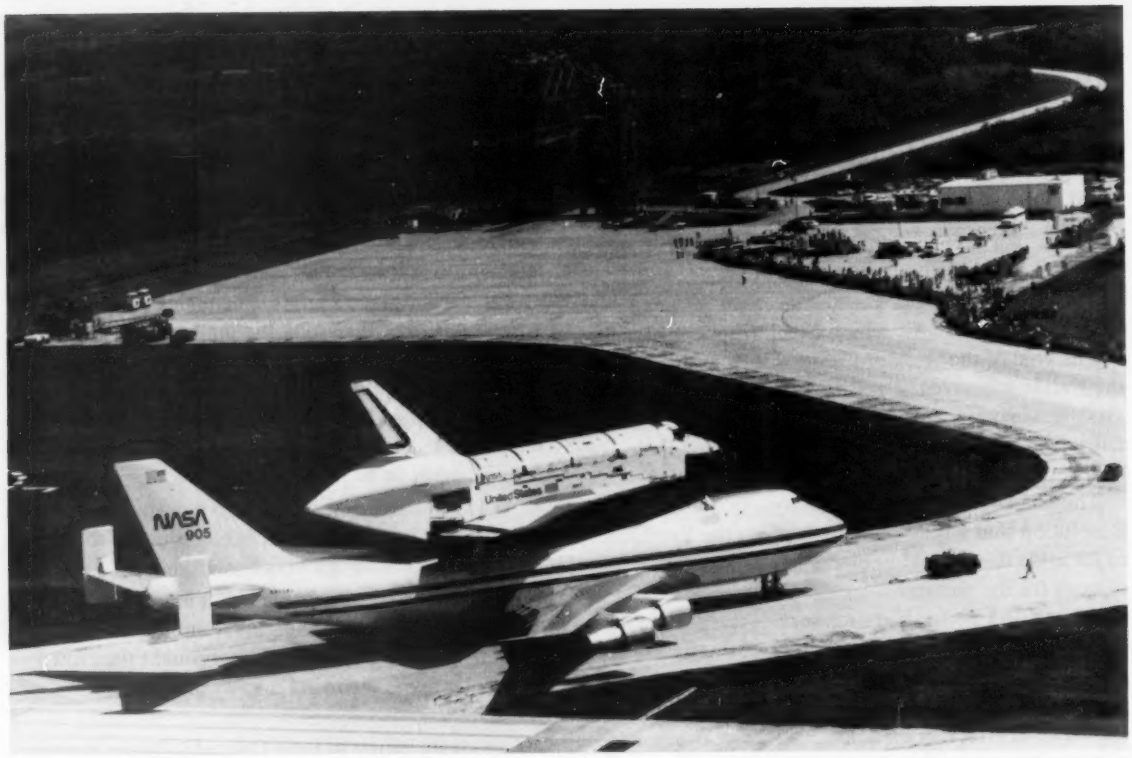
Moments later, orbiter flight test manager Donald "Deke" Slayton, flying shotgun alongside the 747/*Columbia* in a T-38 chase plane, brought the crowd to attention with a stirring display of aerial acrobatics.

Obviously happy to have *Columbia* home, Slayton roared back down the 4-km runway just a few feet off the ground and shot up in a steep climb before thrilling the crowd with a finale of tight aeleron rolls.

A brief ceremony followed the arrival, which was attended by the 747 pilots, U.S. Representative William Nelson, NASA Administrator Robert A. Frosch, KSC director Lee R. Scherer, Florida Lieutenant Governor Wayne Mixson, and Astronauts Robert Crippen and John Young, who will fly *Columbia* on its maiden voyage.

With the 747/*Columbia* combination serving as a backdrop for the speaker's platform, Scherer remarked, "Behind us is a scene we have waited for, for a long time. Particularly the last two weeks have seemed like a long, long time."

Even with the two-week delay caused by bonding problems with some 3,000 temporary tiles mounted on *Columbia* (to supplement the permanent thermal protection system tiles installed to lesson aerodynamic drag during the ferry flight), and a massive slow-moving storm front that preceded and hindered delivery—excitement was still high. Florida Congressman William Nelson summed it up for all of KSC during the ceremony when he said "What a great day."




## President Lauds Shuttle Program

In recognition of the recent arrival of the first Space Shuttle orbiter at its penultimate destination, President Jimmy Carter said:

"The *Columbia,* Space Shuttle orbiter, arrived at NASA's Kennedy Space Center in Florida in late March. Late this year we will be launching *Columbia* into Earth orbit for the first Shuttle mission.

"Just as landing tests of the orbiter *Enterprise* in the summer of 1977 signaled the beginning of the Shuttle evaluation years, the *Columbia* ushers in a whole new era of economical and routine space transportation. The Shuttle will reduce the cost and increase the effectiveness of using space for commercial, scientific, and national security needs. When *Columbia* and her sister ships—*Challenger, Discovery,* and *Atlantis*—are operational, we will truly be the space traveling nation we set out to become twenty years ago.

"The first great era of space is over. The second is about to begin. It will come into its own with the Shuttle, the heart of our new space transportation system. The Shuttle program has been a very large effort. More than 5,000 companies and nearly 50,000 Americans all across the country have worked in designing, manufacturing, and testing the Shuttle. I congratulate the scientists, engineers, skilled workers, and others that have contributed directly to this success."

## NASA-Canada Carry Out Arctic Ice Experiments

Two NASA and one Canadian aircraft with expert research teams in March began remote sensing scans of ice formations off Alaska and the Canadian Northwest to aid in future oil exploration and extraction. Other participants in the one-month experiment were the U.S. Army Cold Regions Research and Engineering Laboratory, the Alaskan Oil and Gas Association and the Arctic Petroleum Operators' Association.

Dr. Richard T. Gedney of the Lewis Research Center and Dr. Rene Ramseier of Canada's Surveillance Satellite (SURSAT) Project Office were principal investigators and coordinators for the international project which was conducted to develop all-weather, day and night remote sensing methods for obtaining ice information.

Ice information is critically needed for further development of reserves consisting of an estimated 230 billion barrels of oil and 530 trillion cubic feet of gas in the Arctic, half of which lie offshore on the continental shelf. Prudhoe Bay alone may contain some 25 percent of known U.S. oil reserves. Tapping these reserves under the Arctic ice pack depends on developing economical and safe offshore exploration and extraction systems as well as satisfactory marine transportation.

The seasonal motion of the ice pack creates surface irregularities or ridges and large variations in ice thicknesses. These result in the formation of multi-year ice floes of much greater thickness and strength than first-year ice. Measurement of ice ridge heights and identification of multi-year ice floes therefore are important in planning offshore oil explorations.

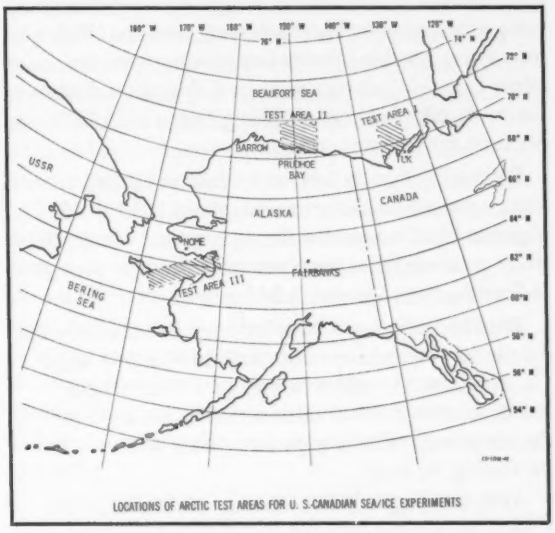
Some of the goals for the sea/ice experiments now in progress are to measure ice ridges 10 or more meters high, and to devise methods for identifying and automatically mapping multi-year ice floes. Radar mapping procedures showing the type, distribution and thickness of ice cover originally were developed in 1974 by NASA Lewis for aiding winter navigation on the Great Lakes.

Other scientists involved in the project are William Campbell of the U.S. Geological Survey, Carole Pease of the National Oceanographic and Atmospheric Administration, Linwood Jones of NASA's Langley Research Center, Ray Stanley of NASA's Wallops Flight Center, Don Montgomery of NASA's Jet Propulsion Laboratory, and Sealy Martin of the University of Washington.

In all, about 50 scientists and flight specialists are involved in the closely coordinated air, ground and sea operations.

In 1976, with the Coast Guard and Navy, the Lewis center demonstrated an all-weather, near real-time ice information system designed to aid Arctic coast shipping along the Alaskan North Slope. The system used side-looking airborne radar installed on a U.S. Coast Guard HC–130B aircraft.

In 1975–76, Drs. Ramseier and Campbell were principal investigators in a joint U.S./Canadian experiment to study the motion and properties of the Arctic ice pack. As part of that experiment, scientific teams lived on the ice pack for a year gathering the ice property and motion data in conjunction with aircraft and satellite studies.



LOCATIONS OF ARCTIC TEST AREAS FOR U. S.-CANADIAN SEA/ICE EXPERIMENTS

## Satellites Cut Industry, Government Costs, Study Claims

Satellite observations of the atmosphere and surface of the earth are saving industries and government agencies at least $172 million a year and perhaps many times that amount, a recent government analysis has suggested. The findings are based on reported use of information provided by geosynchronous and polar-orbiting satellites built and launched by NASA throughout the 1970's for the National Oceanic and Atmospheric Administration (NOAA).

NOAA's GOES (geostationary) and Tiros class (polar orbiting) spacecraft make up the two meteorological satellite systems that were studied by W. John Hussey and E. Larry Heacock of NOAA's National Environmental Satellite Service. Their analysis confines itself to nine activities in which annual savings could be estimated with some degree of confidence.

The agricultural industry—especially the citrus growers in Florida—may be the biggest beneficiary of savings from spacecraft. But use of satellite data (principally imagery) can produce large savings for agriculture, marine shipping and fisheries.

In Florida, imagery from a NOAA geosynchronous satellite is computer-processed to provide a temperature map every 30 minutes that shows the southward progress of crop-killing frost during winter nights. NASA, NOAA, and the University of Florida are participating in this NASA-supported activity. By keeping track of the surface temperature pictures and using a computerized prediction scheme, the NOAA forecasters provide information which allows the citrus growers to decide when or if they should start the costly effort of heating their groves ($833,000 per hour for fuel statewide).

Estimating that an hour and a half of heating protection per cold night are saved, and that 35 to 40 nights in Florida are cold during a typical winter, the study concludes that the potential for annual savings to Florida citrus farmers is $45 million.

The Hawaiian sugar cane industry also uses satellite data in its crop management, and the Waialua Sugar Co. estimates $1 million in savings a year through use of satellite weather information as the basis for deciding when to burn sugarcane fields before harvesting the crop.

As to other agricultural savings, the authors cited a 1973 NASA-funded study conducted by the Space Science and Engineering Center of the University of Wisconsin, which concluded that improved weather information and forecasting could have saved crop growers and processors $74 million in 1971. Short-term forecasts are of particular value in crops that yield perishable products and require precise production techniques.

Before the use of satellite data, the Great Lakes were usually closed to shipping for about two months each winter because of ice. After aircraft-carried, side-looking radar and satellite data showing ice location became available two years ago, however, the 1976–77 season was extended by a month. During the 1977–78 season, shipping on the lakes never came to a complete halt, due in part to the improved ice information available. The study estimates the total cost benefit at about $35 million during the 1977–78 winter.

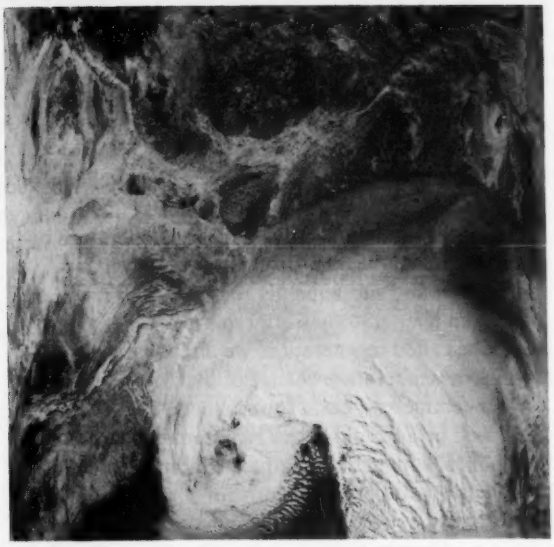
Gulf of Mexico and Atlantic Coast shipping interests also realize savings by using satellite data to locate the ever-changing positions of the Gulf Stream and the Gulf Loop Current. In 1975, seven EXXON Company oil tankers used satellite data to catch the northbound currents of the axis of the Gulf Stream on northward transits, and to avoid the current on southward trips. The EXXON study indicated that the use of this satellite data in navigation has demonstrated potential annual fuel savings for the total fleet of 15 EXXON tankers of about $360,000. The oil company now is using satellite information to help guide all of its vessels navigating along the east coast.

For the last three years, fishermen in the Pacific Ocean have been using satellite-derived information on the location of thermal boundaries in the ocean where salmon and albacore tend to congregate because of the high nutrient levels of the waters. The combination of fuel savings and "additional catch advantage" afforded by the satellite infrared data has an estimated annual benefit of $2,440,000.

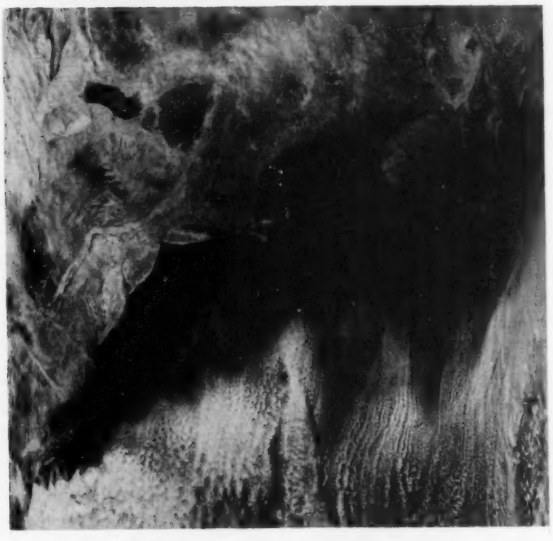
Among Federal agencies, the Air Force and the Coast Guard have the highest annual savings attributable to satellite data, according to the NOAA report. The U.S. Air Force Aerospace Rescue and Recovery Service was able to reduce search and rescue missions flown by C–130 aircraft—at $995 an hour—by 7,000 hours in both 1976 and 1977 because of satellite data, for annual savings of almost $7 million. Satellite pictures showing bad weather conditions when missing aircraft communicated for the last time are used by the California Civil Air Patrol to permit searchers to focus their efforts in those areas, thus reducing by as much as 60 percent the average number of hours flown per rescue mission. The California CAP estimates annual fuel savings of $344,000.

The Coast Guard's International Ice Patrol realizes cost reductions of about $5 million a year in savings of aircraft flight hours and related costs because of satellite ice analysis, which aid planning and locating areas where visual reconnaissance missions can be flown with greatest efficiency.

Also benefiting from polar satellite imagery of ice is the U.S. Military Sea Lift Command which estimates savings of $8,000 per day for every day of



**Looking Down Upon a Disaster**—The great blizzard of 1979, as seen from Tiros-N, shows snow falling on much of the east coast of the United States. The storm front was moving counterclockwise in this photo, taken Feb. 19. The lower east coast can be seen at lower left; part of Lake Erie is visible just above left center.



**In the Wake of the Storm**—The next day snow and ice brought commerce nearly to a dead stop along the eastern shore. Tiros-N photo shows that snow fell thickly to a point just south of New England. Streams of clouds (across bottom) were being blown south by an Arctic wind.

operations in routing its ships through Arctic waters.

In addition to viewing ice, satellites also can "see" the extent of snow cover. This capability has reduced by $100,000 a year the cost of mapping snow cover in the Sierra Nevada river basins, an activity of vital importance to water resource and flood control managers previously dependent upon aircraft overflights.

The cost of airplane reconnaissance of hurricanes in mid-ocean regions also has been slashed dramatically—by about $1.8 million a year—through use of satellite images to detect and monitor the growth and movement of the storms. An even greater saving may be realized because satellites let weathermen be more precise in pinpointing the exact location of a hurricane at sea. This can permit a narrowing of coastal areas that must come under a hurricane warning—notification that an offshore hurricane may make landfall in the vicinity. When such warnings are issued by the National Hurricane Center for a typical Gulf of Mexico hurricane, about 300 nautical miles of coastal area are affected at a cost of about $25.1 million including losses due to temporarily curtailed production. More precise location of an offshore storm, which results in a reduction of even five percent in the coastal warning area, would offer annual savings to the economy of about $2.5 million.

The NOAA report points out that other important activities made possible by satellite-provided information, such as local and global weather forecasting, do not allow for easy computation of dollar savings or of cost benefit. But the value, the authors believe, is in the "many millions of dollars." And the saving of life by improved disaster warnings of hurricanes, severe thunderstorms and heavy rainfall or snowmelt is beyond dollar value and altogether impossible to quantify.

The report adds: "The advent of satellites is perhaps the greatest significant advance in routine environmental monitoring that has been developed in history . . . contributing towards the savings of lives and property from natural disasters and improving the efficiency of the national economy."

NASA plans the launch of another weather satellite for NOAA next month from NASA's Western Test Range in California.

## New Heat Pump Technology Demonstrated

Seven years of research and development work by scientists at the Lewis Research Center have paid off in the creation of a new and practical method of producing heating and cooling. The method employs a "rare-earth" metal called gadolinium, incorporated in a new device called a magnetic heat pump. It apparently represents a more efficient alternative to existing methods, and its use promises a substantial potential saving in equipment, energy and some of the operating costs for many industrial, commercial and perhaps even residential applications.

Ordinary heat pumps typically give only 40 percent as much heat or cold as might be provided by a totally efficient machine for the same investment of energy. But the special characteristics of the magnetic heat pump, Lewis researchers say, should achieve 60 percent efficiency. Thus half again as much heat or cold could be produced using the same amount of energy.

Conventional heat pumps, commonly used today for heating, cooling and freezing, operate on the principle that fluids evaporate at varying temperatures and pressures. They generally employ freon or ammonia as refrigerants. The magnetic heat pump, on the other hand, uses a magnetic solid as the refrigerant. Its operation is based on the natural phenomenon that many magnetic materials become warmer when they are subjected to a magnetic field and cooler when that field is removed.

Gerald V. Brown, magnetics and cryophysics specialist at Lewis and inventor or the new magnetic heat pump, says:

"Conventional heat pumps are capable of producing heat of a sufficient level to warm homes and buildings. With a twist of a valve, they also can produce air cold enough to cool these same buildings or to provide chilling for such commercial applications as dairy plant operations, food processing or ice manufacturing. But to achieve these levels of climate control, heat pumps must be able to produce temperatures as high as about 49 degrees C and as low as about −18°C, a range of at least 67°C.

"Heretofore we could not duplicate this performance magnetically because all the magnetic materials previously investigated could produce temperature changes of only one or two degrees. And while scientists have been creating super-cold temperatures (near absolute zero) magnetically in their laboratories for the past 40 years, they have never been able to produce useful cooling or heating at room temperatures.

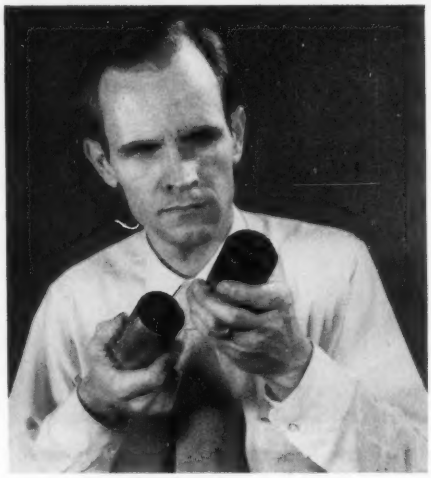
"This difficulty was overcome by verifying that gadolinium (a "rare-earth" element discovered in 1880 and used today in TV tubes and microwave applications) should indeed produce a large change in temperatures when subjected to a magnetic field.

"In fact, gadolinium will change in temperature by as much as 14°C when a strong magnetic field is applied to it and subsequently removed, and it will do so at room temperature. Furthermore, by using a technique called regeneration, we already have achieved a temperature change of over 60°C."

On a commercial basis, the magnetic heat pump could well be a candidate for replacement of all but the smallest conventional units, including those used in industrial refrigeration plants for such purposes as freeze drying, food processing and cold storage, and others used for the heating and cooling of medium to large buildings, plants and ships.

Other possible applications, at much lower temperatures, include the liquification and separation of air (e.g., to supply oxygen for steel mills), the liquification of natural gas and the liquification of lower-boiling gases such as hydrogen and helium.

Deposits of gadolinite, the ore from which gadolinium is extracted, are known to exist in the United States, India, Africa and the Scandinavian countries and known reserves in the free world exceed one million tons.



**Magic Metal**—Inventor Gerald Brown of the Lewis center displays gadolinium, the metal that serves as the key element of a new magnetic heat pump.

## Shuttle Ground Vibration Testing Completed

A nine-month long Space Shuttle ground vibration testing program was completed successfully in February at the Marshall Space Flight Center. All Shuttle elements—the orbiter, external tank and solid rocket boosters—were assembled in the Marshall dynamics test stand in the test program which began in May 1978.

In all, three basic test configurations of the Shuttle were set up to match conditions to prevail during the various phases of actual flight.

The orbiter *Enterprise* arrived in Huntsville early in 1978, after flight approach and landing tests in California. It was first mated in the test tower with an external tank, the unit that supplies liquid propellants to the orbiter's three main engines. This linkup provided data about the high-altitude portion of a Shuttle flight.

In the second phase of testing, the tank and *Enterprise* were removed from the stand and solid rocket boosters filled with inert propellant were stacked inside the tower. The two were put back into position for the first mating of a complete Space Shuttle. This configuration provided data about the liftoff portion of a flight.

The third and final condition was obtained by removing all elements from the stand again and replacing them exactly as they were, but with the solid rocket boosters empty. This simulated the point in a Shuttle flight, some 43.5 kilometers high, just before the recoverable boosters separate to parachute back into the ocean.

With the Shuttle linked in its various configurations, shakers were connected to the vehicle at many critical points and sensors were attached to the vehicle at several locations. Test engineers could then "excite" the Shuttle at selected places and determine the physical reactions at all locations.

Eugene Cagle, charged with overall management of the vibration test program at the Marshall Center, said that the testing "provided a detailed understanding of the structural dynamic characteristics of the vehicle. This gives us confidence, that the Shuttle will withstand the vibration forces it will encounter during powered flight into Earth orbit."

## Small Aircraft Under Study May Cut Noise by Half

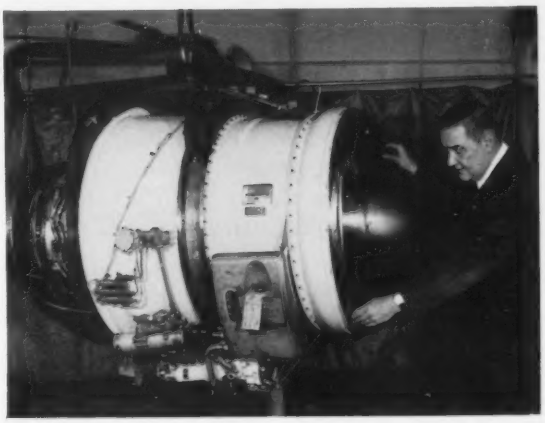
Preliminary test results from two experimental engines designed for general aviation aircraft indicate significantly reduced noise and pollutant emissions, according to the Lewis Research Center.

Flyover noise levels, compared to the quietest current business jets, are predicted to be about 10 decibels lower for one research engine and about 14 decibels lower for the other engine. These correspond to 50- to 60-percent reductions in perceived noisiness, researchers said.

Another way of indicating quietness of an aircraft is the size of its noise "footprint," which is the ground area below the aircraft's path that is subject to noise during takeoff and landing. The noise footprint for an aircraft using one of the new engines is predicted to be one-tenth that of the quietest current business jets.

The program objective of QCGAT—quiet, clean general aviation turbofan—is to demonstrate applicability of large turbofan engine technology to smaller general aviation turbofan engines. The aim is to achieve major noise and pollution reductions while cutting back or maintaining current fuel consumption levels.

One QCGAT engine was developed and tested by the Garrett AiResearch Manufacturing Company of Phoenix, Arizona. The other is being developed and tested by the AVCO Lycoming Division of Stratford, Connecticut. Both engine programs are managed by the Lewis center.



**Less Noise, Less Pollution**—G. Keith Seivers, QCGAT project manager at Lewis inspects the first of two new engines, this one manufactured by Garrett AiResearch.

G. Keith Sievers, QCGAT project manager at Lewis, said:

"In the past, NASA has principally directed research efforts in aeronautical propulsion toward the commercial or large aircraft field. Now, with the QCGAT program, NASA is extending its research and technology into the small aircraft field, which accounts for 38 percent of the intercity air passenger load in the United States.

"With preliminary test results as shown, the QCGAT program is clearly demonstrating that noise need not be a major constraint on the future growth of turbofan-powered aircraft in general aviation," said Sievers.

Lewis reported that the noise level reductions predicted are achieved by slowing down the velocity of the engine exhaust and—through proper acoustic design of the interior parts of the engine including addition of sound absorbing materials—to quiet the noise produced by the engine fan, compressor and turbine.

As to air pollution, a 54 percent reduction in carbon monoxide emissions and a 76 percent reduction in unburned hydrocarbon emissions from current engines are expected for the AiResearch engine. Emission levels from the AVCO Lycoming engine are expected to be even lower.

Testing of the AiResearch engine is essentially complete and delivery of the engine was made to Lewis in January. The Lycoming engine is in an early phase of testing with delivery to Lewis expected in July. Both engines will be used by Lewis for further research.

## NASA Aircraft Scans Southern Skies

The speed of Earth traveling through space was charted by a NASA high-altitude aircraft, a Lockheed U-2, whose scientific research was done with the approval of the Government of Peru. Operations were out of the Jorge Chavez Airport near Lima, from March 2 to 6. Excellent cooperation was given to the NASA operation by the Peruvian Government's Naval Air Force.

The aircraft successfully completed four evening scientific flights over international waters and Peruvian air space, carrying as its only payload an upward-looking differential microwave radiometer. The radiometer is a device for measuring tiny differences in the universal background microwave radiation at extremely low temperatures simultaneously in two different parts of the sky, 60 degrees apart.

These measurements then are used to measure the movement and speed of Earth and our galaxy, the Milky Way, with respect to the far distant matter of the universe. Measurements are based on the theory that microwave radiation emanated from the creation of the universe some 15 billion years ago in a "big bang" or explosion, and that all the matter in the universe has been and still is expanding. Similar measurements made by the same aircraft and experiment in the Northern Hemisphere in 1976–77 support these theories and the belief that our Milky Way and Earth are traveling through space at 1.6 million kilometers per hour. Earth seems to be moving in the direction of the Constellation Leo or the star Regulus.

**Skyline Scanner**—The NASA U–2 aircraft at the Peru Jorge Chavez airport.

The scientific experiment team was represented in Peru by Drs. George Smoot and Phil Lubin of Lawrence Berkeley Laboratory of the University of California. Dr. Luis W. Alvarez, Nobel prize-winning physicist of the University of California at Berkeley, was an early sponsor and enthusiastic proponent of these experiments. The scientists need this Lima expedition to obtain coverage of the Southern Hemispheric celestial areas. Results of the Lima night flights will be compared with the previous experiments conducted in the Northern Hemisphere, with the goal of further substantiating evidence that the "big bang" theory is correct.

Simultaneous measurements were made by a ground-based instrument that measures the polarization (directions of vibration) of the cosmic radiation —the remnants of the microwave radiation that emanated from the "big bang"—as an additional test of the theories under study.

The NASA team in Peru, headed by James Cherbonneaux, Chief of the High Altitude Missions Branch at the Ames Research Center, consisted of 18 NASA and Lockheed Aircraft Company people.

The scientific payload, including support equipment and the radiometer, weighed about 135 kilograms. During the science mission, the aircraft flew 160-km legs at right angles to each other at a latitude of about 16 to 17 degrees south. The radiometer collected data at two different points in the sky during each four-hour mission. The four missions covered eight different celestial areas in two-thirds of the Southern Hemisphere.

The U–2 was chosen for the experiments because it can fly at altitudes as high as 19,500 meters where the extremely low atmospheric water vapor will not significantly affect measurements.

Lima was chosen by the scientific and operational team members as the best operational base for the aircraft because from there the U-2 could reach the southern latitudes necessary to obtain the required data.

Scientific results and conclusions of the 1976–77 flights over the United States have been published by the experiment team in *Scientific American* and in *Physical Review Letters*. Results from the Peru-based expedition will be published in similar scientific journals when analysis is complete.

## Washington Symposium

A symposium on mathematical programming with data perturbations will be held at the George Washington University May 24 and 25. The stated purpose of the symposium is "to bring together practitioners who use optimization models and who have to deal with questions of sensitivity analysis, with academic and other research workers who are developing tools applicable to these problems."

General chairman Anthony V. Viacco of GWU believes that the event is a particularly good opportunity for NASA and other agencies, companies and universities in the greater Washington, D.C. metropolitan area to become involved in concentrated discussions in a subject area of great importance to applications.

Additional information may be had by calling Viacco at GWU (202/676-7511).

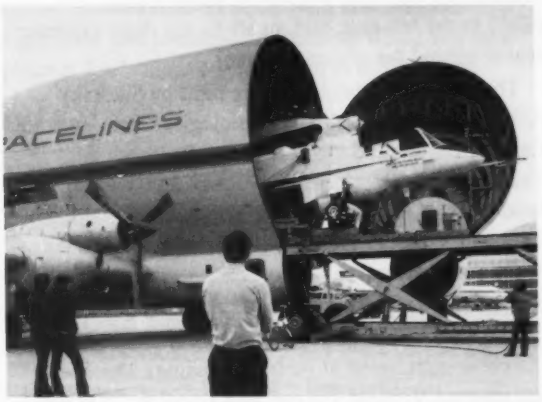
## Advanced Research Aircraft

The two Rotor Systems Research Aircraft (RSRA) under study at the Ames Research Center are unique research vehicles designed to provide a national facility for in-flight investigation and verification of promising new helicopter rotor system concepts and supporting technology.

Jointly funded by NASA and the United States Army, the RSRA aircraft are used in a program of helicopter technology research to increase rotor aircraft speed, performance, reliability and safety, and to reduce helicopter noise, vibration and maintenance.

The RSRA can be configured to fly as a helicopter or as a compound helicopter (helicopter with fixed wings and auxiliary jet engines). The vehicle can be fitted with a variety of experimental and developmental rotor systems for research purposes. In the compound configuration, with the wings providing a portion of the needed lift, rotor systems too small to support the aircraft can be accommodated.

A unique rotor vibration isolation system is available which prevents transmission of main rotor vibrations to the fuselage structure. This allows installation of various rotor systems with a wide range of vibration characteristics on the RSRA without modifications to the fuselage. At the same time, the system provides precise measurements and control of




**Rotor Systems Research Aircraft**—NASA's newest research airplane is shown being unloaded from the Aero Spacelines Super Guppy at the Ames center. After completion of initial flight testing at the Wallops center, the RSRA was flown to the California center. The Super Guppy was built in 1965 and has been used to haul a variety of outsized cargos, including massive rocket stages for the Saturn launch vehicles used in the Apollo program.

rotor forces and of aircraft maneuvering flight parameters over a wide range of operating conditions.

In the helicopter configuration, the RSRA has a design gross weight of 9,200 kilograms. It is powered by a Sikorsky S–61 rotor and drive system. The horizontal stabilizer is a "T" tail with a 4.1-meter span and an area of 2.4 sq.m.

In the compound configuration, the RSRA has a design gross weight of 13,100 kg. Wing and auxiliary thrust jet engines are added to the helicopter and the tail is modified with the addition of a 6½-m span stabilator (stabilizer-elevator) and a rudder and associated controls. The wing has a 14-m span and includes both aileron and flap surfaces.

An emergency escape system is provided for the crew. When the full egress mode is actuated, an all-pyrotechnic system severs the main rotor blades, jettisons and fractures the canopies, and initiates the crew extraction system. Tractor rockets connected to torso harnesses extract crewmembers and initiate parachute deployment. When in the compound helicopter configuration, an alternative "blades only" mode may be selected. This mode provides for jettisoning the blades in the event of rotor problems that threaten the aircraft and permits flight as a fixed-wing aircraft.

The crew consists of a safety pilot (aircraft commander) in the right seat, an evaluation pilot (co-pilot) in the left seat, and an aft-facing flight engineer seated behind the evaluation pilot.

The two RSRA vehicles were built by Sikorsky Aircraft Division, United Technologies Corp., for the Langley center, and the U.S. Army Research and Technology Laboratories (AVRADCOM), with headquarters at Moffett Field. Following initial flight testing in Virginia, the two aircraft were transferred to the Ames Research Center, for an extensive flight research program by Ames and the Army.

The RSRA joins NASA's growing stable of research aircraft based at Ames, including: The X–14 jet-powered Vertical Takeoff and Landing (VTOL) research aircraft, the Augmentor Wing Jet STOL (Short Takeoff and Landing) Research Aircraft, the Tilt-Rotor Research Aircraft (also a joint research program with the US Army), and the Quiet Short-haul Research Aircraft. These research aircraft are used in a broad research program at Ames to develop technology for safer, quieter and more efficient VTOL and STOL aircraft of the future.

## Windy City Looks Closely at Space

A recently completed summary report by the Lewis Research Center describes a highly successful program that took place last winter in Chicago. Called "Chicago Meets Outer Space," the one-week aerospace education program was co-sponsored by NASA and Chicago State University, with additional sponsorship by the City of Chicago's Department of Human Services and the American Institute of Aeronautics and Astronautics. The event was followed by "Chicago Spacewatch," in which the National Space Institute (with an assist from NASA) put on a special, three-week-long educational program for Chicago residents.

Called a huge success, the double program brought the space message to thousands of people throughout the midwestern city. Speakers consisting of scientists, industry leaders, educators, astronauts, environmentalists and entertainers addressed subjects in general related to benefits accruing from the space effort.

The NASA education program, held at the Chicago State University campus, attracted some 7,500 inner-city students and teachers from high schools and elementary schools.

Speakers concentrated generally on topics such as: What we've learned from space, and how space technology is being used to solve the problems on Earth; spinoff technology and products; the future and things that could be accomplished now with existing technology; "Getaway Special" program; and career opportunities. A symposium featured astronauts, NASA exhibits, souvenir photos for each student, a live demonstration of the workings of the Communications Technology Satellite, a teachers workshop, and demonstrations of space food.

## Setting the Record Straight

Concerning the Skylab photo that appeared on page 20 of the February *Activities*, captioned information apparently was somewhat misleading.

R. J. Schwinghamer, director of the materials and processes laboratory at the Marshall Space Flight Center—a member of the NASA team that bent every effort toward rescuing the foundering Skylab—very kindly supplied accurate details about that hectic period.

Immediately after Skylab's launch, when it became apparent that wildly inventive repairs were needed

fast to save the mission, several remedies were offered. The first one to be tried was the Johnson Space Center's "parasol," which proved partially effective. But the parasol deployed only 75 percent and the orbital workshop began to heat up again after an initial drop in temperature of 16.7 C.; also, it appeared that the parasol might be deteriorating. On July 19, 1973, therefore, a thermal shield designed at Marshall, called SAIL, was deployed *over* the parasol by the Skylab II crew, which consisted of Cdr. Alan L. Bean, Owen K. Garriott and Jack R. Lousma.

The "composite" thermal shield, made up of parasol and SAIL, served to shield the Skylab quite successfully and the planned mission was successfully completed.

## White Sands Named Backup Landing Strip

*The following article was taken from the JSC publication, Roundup.*

The great white blotch in New Mexico's Tularosa Valley can be seen from the air for a hundred miles or more. Tourists drive out into the gypsum dunes from Alamogordo to view nearby White Sands National Monument.

The place certainly seems like an unusual location for landing a spaceship. But a flat, hardpacked stretch running north and south across the white dry lakebed has been named the backup landing strip for the Space Shuttle orbiter, scheduled for its first space flight in November.

The Northrup strip on the White Sands lakebed was chosen because it remains dry most of the year. Moreover, Northrup strip is under the flight path of the critical first Earth orbit after a Shuttle launch. Should the orbiter not be in a safe orbit, or should some other emergency force a landing on the first orbit, the spacecraft would be slowed down by a de-orbit rocket engine burn high over the South Pacific east of Samoa. As the orbiter entered the Earth's atmosphere, the flight path would cross Baja California and the Mexican state of Sonora until the spacecraft was in denser atmosphere. The crew would fly it "dead-stick" into Northrup strip.

Shuttle orbiter *Columbia* will make six orbital test flights before the Shuttle Transportation System becomes operational. The first four of these test flights will land at Edwards Air Force Base, Calif., and subsequent orbiter landings will be on the 4,500-meter Shuttle runway at the Kennedy Space Center in Florida.

Edwards AFB has a large dry lakebed extending around one end of its main runway that is hard-packed and allows an 11-mile rollout for a landing orbiter. Winter rains can transform the dry lake into a wet lake; and since there is little natural drainage, water removal is mostly through evaporation.

Standing water on the lakebed at Edwards AFB before launch would shift the normal end-of-mission landing to Northrup strip.

Plans are underway for installing a stiff-leg derrick adjacent to the Northrup strip for hoisting a landed orbiter onto the top of the Boeing 747 carrier aircraft used by NASA to ferry orbiters back to Kennedy for the next launch. Additionally, a ground station for the Shuttle microwave scanning beam landing system—a landing and approach piloting aid—will be moved to the strip from Edwards AFB.

Other landing support equipment to be relocated at the Northrup strip include an S-band communications van and a mobile tactical air navigation station to provide orbiter crews with distance and bearing signals from the landing site.

Operational costs for retrieving an orbiter will run about $400,000, and up to 200 NASA and support contractor people would be temporarily assigned to the Alamogordo-Northrup Strip area for a retrieval.

The contract is valued at $2,935,000 and covers spares, ground support equipment and manuals, and flight crew and maintenance training which will take place at JSC's flight operations area at Ellington.

## NASA Receives Voluntary Contribution

Last month the following handwritten letter—which speaks for itself—was received at headquarters:

"Dear N.A.S.A. Co.

I love to look at Jupiter. plus I think you're a great Co. And could you send me a model rocket?

When I grow up I would like to take a vacation on Uranus.

Here are twenty-five cents [enclosed] so you can run the Co.

from Chris Todd

Chris Todd
RD #1
Felton, Pa. 17322"

## Marshall Center People Receive Awards

Three aerospace engineering technicians at MSFC received Presidential letters of commendation and cash awards recently for suggestions of value to NASA. All three work in the center's test laboratory.

Howard D. Luna's suggestion resulted in estimated first year savings of $5,592, for which he received $517; an idea suggested by William J. Mullins and Elgan F. Bledsoe saved $5,760 during the first year. They shared a cash award of $523.

## NASA Man Wins AIAA Aeroacoustics Award

Harvey H. Hubbard, assistant chief of the acoustics and noise reduction division at the Langley Research Center since 1973, has received the American Institute of Aeronautics and Astronautics (AIAA) Aeroacoustics Award for 1979. He is the first U.S. citizen to receive this distinguished award.

The AIAA presents the award annually for an outstanding technical or scientific achievement by an individual's contribution to the field of aircraft community noise reduction.

The award was presented to Hubbard at an awards luncheon during the fifth AIAA Aeroacoustics Conference in Seattle, Wash. Hubbard's citation reads: "For outstanding scientific contributions to understanding and reducing the generation, propagation and effects of aircraft noise."

A native of Swanton, Vt., Hubbard received a bachelor of science degree in electrical engineering from the University of Vermont in 1942 and has performed graduate work in aerodynamics at the University of Virginia.

Hubbard began his career with NASA's predecessor agency, the National Advisory Committee for Aeronautics (NACA), in 1945 as a flight vehicle acoustician.

Before he came to Langley, Hubbard was employed at Westinghouse Manufacturing Co. for a short period in 1942, where his work resulted in a U.S. patent for a flame-quenching device in circuit breakers. From 1942 to 1945 he served as an officer in the U.S. Army Signal Corps and Air Corps. He retired with the rank of Lieutenant Colonel in the Air Force Reserves.

The author or co-author of more than 100 technical reports, journal articles and book chapters, Hubbard received the NASA Special Service Award for Exceptional Service in 1967 and for Outstanding Scientific Achievement in 1968, the Group Achievement Award in 1968, and the Gold Medal for Outstanding Scientific Achievement in 1969. The Silver Medal Award of the Acoustical Society of America was presented to Hubbard in 1978 for his contributions to the understanding of aircraft noise, its generation, propagation, and control, and its effects on people and structures.

Hubbard is a fellow of the Acoustical Society of America; associate fellow of AIAA; president of the Institute of Noise Control Engineering; and a charter member of the British Institute of Acoustics.

## Raney in New OSTA Post

Dr. William P. Raney has been named Assistant Associate Administrator for the Office of Space and Terrestrial Applications (programs) effective Dec. 31, 1978. Raney has been chief engineer for the Office of Space and Terrestrial Applications since April 1978.

Before he joined NASA, Raney served with the Office of Science and Technology Policy, Executive Office of the President. His duties on that staff were primarily concerned with the programs of basic research in the mission agencies of the government. In addition, he was the executive secretary of the Federal Coordinating Council for Science, Engineering, and Technology.

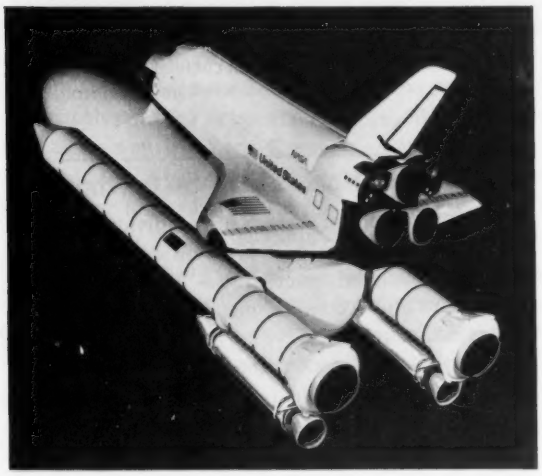
From 1972 to 1977, Raney was deputy and chief scientist in the Office of Naval Research where he had the technical responsibility for the direction and coordination of the basic research program of the Navy. During that time, Raney also served as the executive chairman of Subgroup G (undersea warfare) of the Technical Cooperation Program, which works on promotion of technical information among the United States, United Kingdom, Canada, Australia, and New Zealand. He was the U.S. member of the scientific committee of national representatives to the NATO Antisubmarine Warfare Centre in La Spezia, Italy.

Raney served from 1964 to 1972 on the staff of the Assistant Secretary of the Navy for Research and

Development as the special assistant for research. He also served as a focal point in the Secretariat for the Navy's in-house laboratories and directed the planning for a major realignment of the organization and management of the Navy's laboratories.

## Shuttle Thrust Power Studies Underway

Preliminary studies have begun at the Marshall center on increasing the thrusting power of the Space Shuttle by attaching strap-on rocket motors to the Shuttle's solid rocket boosters. John F. Yardley, Associate Administrator for Space Transportation Systems, said that the additional thrust is necessary to insure that the full Space Shuttle system payload deployment capability of 14,500 kilograms can be achieved for a 98 degree inclination, 277,800 kilometer circular orbit mission launch from Vandenberg Air Force Base. Early definition work at Marshall is expected to lead to the awarding of a contract in FY 1980 for analysis, testing and design of the selected strap-on concept, to be followed by procurement of hardware to support the launch of an augmented Shuttle by mid-1984. The strap-on motors would be attached to the rear section of the Shuttle solid rocket boosters. The small strap-on rockets are expected to be about one-fourth the length of the boosters, which are about 45 meters long.



## Langley Manager Takes New Job at Headquarters

Angelo "Gus" Guastaferro, lately of NASA's Langley Research Center, has been named director for lunar and planetary programs at NASA headquarters. His most recent post was as manager of the large space systems technology program at Langley.

In his new job in NASA's Office of Space Science, Guastaferro is responsible for management of all unmanned planetary programs, including Voyager and Pioneer. He also manages studies in planetary astronomy, atmospheres and geology; advanced science planning; advanced programming and technology; extraterrestrial materials research; and flight program support.

He succeeds A. Thomas Young, another former Langley manager, who is now deputy director of NASA's Ames Research Center.

Guastaferro, who began his present job in May 1977, is a former manager with the Viking Project. From 1968 to 1975, he held several management positions, including deputy project manager (management). He also managed the rotor systems research aircraft project for 16 months.

He received NASA's Outstanding Leadership Medal in 1977 for his work on Viking, and he received Langley's Special Achievement Award three times (1974, 1976 and 1977) for outstanding work.

Born in Hoboken, N.J., he earned a bachelor of science degree in mechanical engineering from the New Jersey Institute of Technology in 1954, and a Master of Business Administration degree from Florida State University in 1963. He was in the U.S. Air Force from 1955 to 1958.

Guastaferro joined NASA in September 1963 as a resident engineer and Scout project manager at the Vought Corp. in Dallas, Tex. He became Langley mission support office manager at Vandenberg Air Force Base, Lompoc, Calif., in May 1966, and transferred to the Viking Project at Langley in 1968.

## Twentieth Birthday of Space "Workhorse"

The Agena rocket was born 20 years ago, on Feb. 28, 1959. The Agena is a vehicle whose maneuverability, versatility and reliability have made it one of the world's most flown, most successful spacecraft.

Designed, developed and manufactured by Lockheed under contract to the U.S. Air Force, the Agena since 1959 has carried out well over 300 space missions for NASA and the Air Force. Often called the "workhorse" of the U.S. Space Program, Agena is probably best known to the public for its contributions toward America's efforts to put man on the Moon. An Agena vehicle boosted the first Moon surveyor vehicles, which led to pinpointing Apollo lunar landing sites, and it served as the target vehicle for a Gemini spacecraft during the first rendezvous and docking in space. This feat proved the feasibility of the docking mechanism used during Apollo missions.

The three-axis, stabilized Agena is completely controllable and completely maneuverable in space. It has carried more different types of power supply, has had more restarts in orbit and has been used on more different boosters—the Thor, Atlas, Thrust Augmented Thor, Long Tank Thor, Thorad and Titan III–B—than any other spacecraft.

Through the reliable Agena, more than a score of world firsts have been written into the record book in the name of the United States. Most noteworthy on this list are:

First spacecraft to achieve circular orbit . . .
First to achieve a polar orbit . . .
First to be stabilized in all three axes in orbit . . .
First to be controlled in orbit by ground command . . .
First to return a man-made object from space . . .
First to propel itself from one orbit to another . . .
First to propel a spacecraft on a successful Mars flyby . . .
First to propel a spacecraft on a successful Venus flyby . . .
First rendezvous and docking of two spacecraft . . .
First space vehicle to provide propulsive power for another . . .
Propelled man to a new world altitude in 1966—852 miles . . .
Propelled man faster than he had ever traveled before in 1966—17,930 miles per hour.

Used for missions varying from a comparatively simple ascent boost to missions involving extended life in orbit, Agena's rate of success is better than 93 percent.

**Early Agena Launch**—The Agena, in combination with an Atlas booster, carries a Ranger spacecraft into orbit from Cape Canaveral.

## National Space Honors to NASA Personnel

The contributions of three NASA individuals and one NASA team to the space program were recognized by the National Space Club—"for outstanding achievements and accomplishments in the fields of rocketry and astronautics."

The awards were made at the 22nd Annual Goddard Memorial Dinner, held in Washington, D.C., March 30.

Dr. Christopher C. Kraft, Jr., director of the Johnson Space Center, won the Dr. Robert H. Goddard Memorial Trophy, "For his outstanding role in manned space exploration and space transportation, and especially his critical role in every manned space flight mission from Mercury through Apollo Soyuz and now on Space Shuttle."

The Pioneer Venus team and its manager, Charles Hall, based at the Ames Research Center, were honored for outstanding contributions to space science. Hall won the Astronautics Engineer Award, "For his personal leadership in the engineering management of the Pioneer spacecraft program over a period of more than 15 years, culminating with the Pioneer Venus probes of 1978." The Pioneer Venus team (Hughes Aircraft Co., and the Ames center) was cited "For successfully sending to Venus two complex spacecraft including an orbiter and an array of atmospheric entry probes that are conducting the most detailed scientific examination ever undertaken of the Earth's cloud-shrouded neighbor.'

Dr. Dallas G. Denery of the Ames Research Center was awarded the Dr. Hugh L. Dryden Memorial Fellowship, "For outstanding performance in avionics research and program management." The fellowship grant is for $2,000.

In his keynote speech, NSI's president Hugh Downs offered encouraging words for the Space Shuttle program. Among other things, he said:

"July 20, 1979, will mark the tenth anniversary of the historic Apollo Moon landing. The world was dazzled by the sight of the first man to set foot on the moon. And space was dubbed the new frontier, an awesome medium for exploration and discovery.

"Since then, we have continued to probe the solar system for better understanding of our galactic community with such repeated success that the public image of space endeavors has shifted from adventurous exploration to pragmatic exploitation of this advantageous environment. Constant achievement has put an end to the nail biting and breath holding. Success is no longer hoped for; it is expected.

"Today, in a climate of confidence, we stand at the threshold of a new era in space utilization. And the wings to carry us from the old era to the new belong to the Space Shuttle Transportation System, which will usher in a period of routine, economical access to space. . . .

"If the space transportation era is thought to lack the glitter and drama of earlier space programs, it is because it lacks the anxiety; it does not lack in excitement. Shuttle was conceived and planned to respond to the needs of the 1980's and 1990's. The scientific and technological breakthroughs, medical advancements, manufacturing innovations and possible new materials, ecological understanding, and energy development that will result from the program—not to mention the serendipitous benefits that attend major interdisciplinary enterprises—can offer timely solutions to our most pressing problems and are certain to improve the quality of life on earth. On the horizon is the dawn of a new era of accelerated progress for mankind. Shuttle—on the eve of its first manned flight—is its harbinger."

## New Director for OSTA Division

Dr. John H. McElroy recently was named director of the communications division, Office of Space and Terrestrial Applications.

Before he joined the headquarters staff, McElroy served for 12 years at Goddard Space Flight Center, most recently as chief of the communications technology division. During his years at Goddard, he was responsible for research and development of laser communications, tracking, and remote sensing instruments, and advanced satellite communications technology.

Earlier, in the sixties, McElroy served in the quantum electronics research laboratory of the University of Texas at Austin where he participated in research on laser-induced ionization of high-pressure gases. Before that he was an electronics instructor and technical writer on various U.S. Army air defense guided missile systems.

McElroy has a BSEE from the University of Texas and an MEE and Ph.D from the Catholic University of America. He has been elected to Eta Kappa Nu, Tau Beta Pi, and Omicron Delta Kappa, and is a senior member of the Institute of Electrical and Electronics Engineers and an Associate Fellow of the American Institute of Aeronautics and Astronautics.

## Aviation Award to Langley Man

Harold E. Mehrens, educational programs officer at the Langley Research Center, recently was awarded the Certificate of Merit by the Aviation Distributors and Manufacturers Association (ADMA) "in recognition of outstanding efforts in aviation education."

ADMA bestowed the national award—highly regarded in aviation circles—on Mehrens for his initiative and leadership in establishing the NASA Aeronauticsmobile project, one of aviation's most effective means for bringing to the public understanding of the nature and direction of the nation's aeronautics research and development effort. Established in 1977, the Aeronauticsmobile program annually reaches half a million people at air fairs, air shows, conventions, universities, and secondary schools.

Mehrens, former head of the industrial arts department of the Montgomery-Blair Senior High School, Montgomery County, Md., joined NASA's spacemobile operation as an aerospace education specialist in 1963. In 1965 he was appointed educational programs officer at the Kennedy Space Center, and in 1971 he joined the Langley staff as educational programs officer.

## Civil Service Reform in 1979

*Second installment of new Civil Service regulations as they affect many NASA employees*

In late February, NASA received an allocation from the Office of Personnel Management of 520 Senior Executive Service positions. On March 16, 1979, conversion offer letters were sent to the incumbents of these positions, who will have until June 20, 1979, to make their decisions as to whether they will join SES.

NASA continues to stay current with the carrying out of the new personnel requirements.

The next step for SES is for NASA to implement its performance appraisal system for SES and to modify its present system for managing executive positions to meet the reform act requirements for an Executive Resources Board and a Performance Review Board. The SES appraisal system will be undergoing field testing soon at several centers and will be fully operational by late summer, 1979.

The NASA Executive Resources Board and Performance Review Board have been established. The first will be responsible for recommending NASA policy as it relates to SES appointment, recruiting, selection, development, evaluation and compensation. The second will review performance ratings and recommended awards to assure that the established policy is fulfilled. Both boards will operate independently to maintain objectivity with overview by the Senior Executive Committee at the Deputy Administrator's level.

Members of the SES Executive Board are: (permanent) Dr. Harriett G. Jenkins (Equal Employment Programs); Neil Hosenball (General Counsel); William E. Lilly (Comptroller); (rotating) Dr. James J. Cramer (Associate Administrator for ASTP), Donald P. Hearth (Langley center director), William R. Lucas (Marshall center director), William C. Schneider (Associate Administrator for OSTDS), Clarence A. Syvertson (Ames center director).

Performance Review Board members are: Leonard Jaffe (special assistant, chief engineer's office), Robert E. Smylie (deputy director, Goddard center), John M. Klineburg (Deputy Associate Administrator for OAST), Gerald Griffin (deputy center director, Kennedy center), Gerald J. Mossinghoff (deputy general counsel, headquarters), Richard G. Smith (Deputy Associate Administrator for STS, hq.), Edwin C. Kilgore (director of administration, Langley center), and Carl E. Grant (director, personnel programs, hq.). Persons in the last-named group will serve on a continuous basis for one, two, or three years.

**His Invention in Big Demand**—Frank J. Nola, the engineer who invented the revolutionary "Power Factor Controller" at NASA's Marshall center, shows a few of the 9,000 (and increasing daily) letters of inquiry he has received. His device has the ability to significantly reduce the amount of energy consumed by the billions of electric motors of all sorts in daily use throughout the world.

# Did You Know?

**"Our Beautiful Earth: The View from Air and Space,"** opened at the Smithsonian's National Air and Space Museum in Washington, D.C. in early May. The exhibit features the work of four contemporary photographers who specialize in aerial views of the Earth—William Garnett, Georg Gerster, Robert Bucknam and George Hall. They shoot from small aircraft at altitudes of 30 to 300 meters and from a blimp. Also included are photographs of the Earth taken by NASA astronauts and by Landsat.

**The Johnson Space Center** had more than a million visitors in 1978. **Kennedy** had 15.4 percent more people taking the bus tour in 1978 than in 1977. The presence of *Enterprise* at **Marshall** brought out sustained crowds and caused freeway traffic jams at Houston. The **National Air and Space Museum** had more than 10 million visitors in 1978.

**"Living Planet,"** the National Air and Space Museum's second feature film, opened to the public in April. The new film carries its viewers over many of Earth's most remote corners—Africa, Venezuela, India and the Arctic. Through air and space flight, the audience gets a fresh perspective of Earth and sees its home through new eyes. The film was produced by Academy award winner Francis Thompson, who also produced the museum's premiere film, "To Fly."

## System Promises Low-Cost Electrical Energy Storage

A unique energy-storage system developed by NASA promises major cost reductions in the storing of electrical energy as well as long-term reliability and minimal environmental impact.

For utilities, the new NASA system could be scaled up in the next several years, depending on funding, to provide electric power companies with an efficient means of load-leveling. Load-leveling means the storing of thousands of kilowatt-hours of energy during low demand periods for use later during periods of maximum power consumption.

More immediately, systems in the kilowatt (1,000-watt) range could help to speed the growth of solar electric (photovoltaic) and wind-energy systems where the cost of electrical storage has been an important consideration.

The storage system is called Redox, for reduction oxidation. It was developed by the Lewis Research Center under a program funded jointly by the U.S. Department of Energy (DoE) and NASA.

"We believe that the REDOX system could be produced for one-third the cost of conventional lead-acid storage battery systems now in use," said Dr. Louis Rosenblum, chief of the solar and electrochemistry division at Lewis. "If that indeed proves true, our REDOX battery system will help make solar electric and wind-energy units more practical and hasten their contribution to our nation's energy supply.

"Beyond solar electric and wind applications," Rosenblum said, "our goal is to enable utilities to store megawatt-hour quantities of energy economically and efficiently. Consequently, utilities may be able to eliminate the need for relatively expensive and less efficient standby generation equipment, usually oil-fueled. The net effect would be to lessen U.S. dependence on foreign oil."

**Space Telescope Program Badge**—This artist's drawing has been designated as the official Space Telescope program badge. The badge will be used by the program for film and video tapes, as well as decals, gummed stickers, patches, etc. In addition, it will be used in the identification of Space Telescope hardware to be provided by the European Space Agency. The badge was selected by the project office from 20 candidate designs solicited from various project elements at the Marshall and Goddard centers. The final design and artwork was prepared by Euel Dean Cagle of Marshall's graphics and models branch.

## Contractor News

**Management and Technical Services Co.** of Houston, Texas, a subsidiary of General Electric Co., has been chosen by NASA for negotiations leading to the award of a cost-plus-award-fee contract for the performance of life sciences flight payload development, engineering and operations. The contract will be for engineering, planning, technical management, operational support and acquisition of equipment to support a life sciences experiment program for flights aboard the Space Shuttle. To run from 1979 through February 1984, the contract will be divided into three periods. Estimated cost for the first two-year period is approximately $8.6 million and $22.9 million for the full five-year contract. The life sciences flight experiments program on the Shuttle will open a new era of medical, biological and performance research in space. Scientists who are not astronauts will be able to perform experiments during space flight. The experiments program is in the NASA Office of Space Science where it is managed by the life sciences program division. This contract is under the management and technical direction of NASA's Johnson center.

**The Lockheed-California Co.,** Lockheed Corp., of Burbank, Calif., has won a modification to its NASA contract on supersonic cruise technology assessment studies. This contract involves technology assessment studies to determine and define the impact of new technology advances on the performance of supersonic cruise vehicles. The value of the modification is about $1.1 million, bringing the total value to $3.3 million. The contract is managed by NASA's Langley center.

**The Douglas Aircraft Co.,** McDonnell Douglas Corp. of Long Beach, Calif., has been awarded a NASA contract to develop and evaluate advanced active controls and aerodynamics technology for subsonic commercial aircraft. Part of NASA's aircraft energy efficient program, the contract is aimed at making commercial transport airplanes 50 percent more fuel efficient by the early 1980s. It will be managed by the Langley center. The contractor estimates the value of this cost-sharing contract to be some $15.7 million, with the government contributing $14.2 million and the contractor contributing approximately $1.5 million.

**The Douglas Aircraft Company,** McDonnell Douglas Corp., Long Beach, Calif., has been awarded a modification to a NASA contract for assessment studies of supersonic cruise technology. The contract, worth about $1 million, involves conducting supersonic cruise vehicle technology application studies to support a program directed toward developing a strong technology base for possible future aircraft development. The modification brings the total value of this contract, awarded in 1976, to $3.3 million. The work will be performed at the Long Beach facility. The contract is managed by the Langley center.

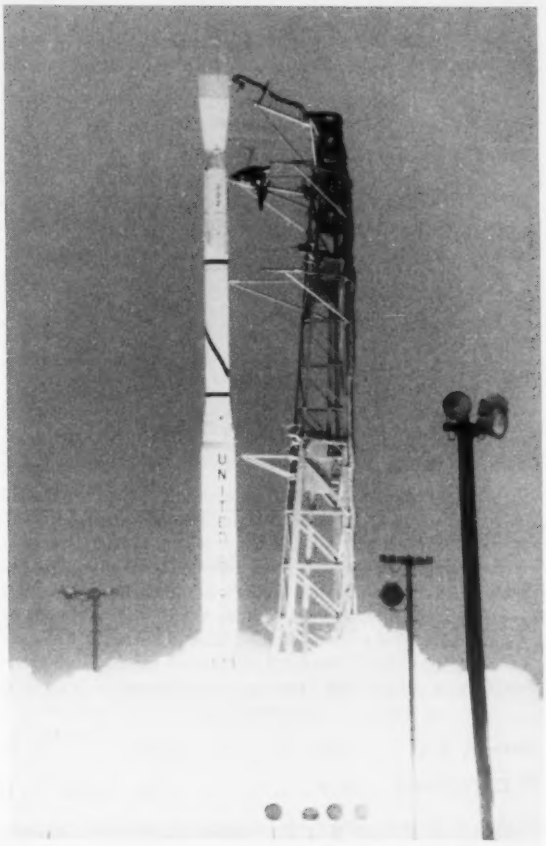
## Recent NASA Publications

*Liquid Hydrogen as a Propulsion Fuel, 1945–1959, NASA SP–4404,* author John L. Sloop. When the Soviet Union launched the first satellite in 1957, the United States was decidedly behind in launch vehicle capability. Technical decisions taken in 1958 and 1959 to use liquid hydrogen in the upper stages of the Centaur and Saturn launch vehicles led to the dramatic successes of the nation's manned space flight program. The decision to liquefy and use the highly hazardous fuel associated in so many minds with the *Hindenburg* disaster of 1937 was particularly bold in light of the serious reservations of many experienced engineers. Hydrogen had been considered in astronautics and aeronautics before but in each case had been abandoned in the face of seemingly formidible problems. NASA's positive decision was later adjudged correct. This book tells the story of the circumstances within NASA that led to technology concerning safe use of liquid hydrogen. Paperbound, 340 pp, for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $5.50.

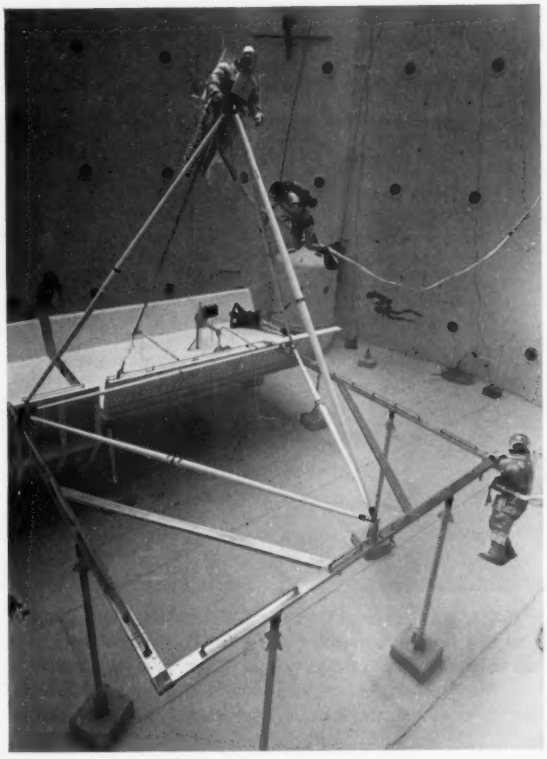
*The Partnership: A History of the Apollo-Soyuz Test Project, (NASA SP–4209*) authors Edward Clinton Ezell and Linda Neuman Ezell. The official NASA history of the cooperative space flight of the United States and the Soviet Union during the summer of 1975. Paperbound. 580 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $8.30.

*Moonport: A History of Apollo Launch Facilities and Operations (NASA SP–4204),* authors Charles D. Benson and William Barnaby Faherty. A publication in the NASA history series that tells the story of the design, construction, and operation of the Apollo launch facilities at the Kennedy Space Center in Florida. Paperbound. 656 pp. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for $8.00.

*Physiological Responses of Women to Simulated Weightlessness: A Review of the Significant Findings of the First Female Bed-Rest Study (NASA SP–430),* authors Harold Sandler and David L. Winter. This report documents the physiological effects on a group of female subjects of simulated space flight conditions at the Ames Research Center in 1973. Contrary to voluminous data available on equivalently aged males, little or nothing. Among the aspects covered are physiologic reactions during bed rest, centrifuge tolerances, and bodily responses to lower negative pressure. The findings of this study should prove helpful in assessing the outlook for people in space and in determining criteria for selecting passengers for the Space Shuttle. Final verification of findings must await operational Shuttle missions in the early 1980's when comparison of the data with actual measurements can be made during and after flights. Paperbound. 96 pp. For sale by the National Technical Information Service, Springfield, VA 22161, for $6.00.



**Satellite for Climate and Environmental Study**—SAGE (Stratospheric Aerosol and Gas Experiment), an applications satellite, as it was launched from the Wallops Flight Center by a four-stage Scout launch vehicle.



**Underwater for Space Test**—Pressure-suited engineers work submerged in a huge tank called a neutral buoyancy simulator at NASA's Marshall center to study assembly techniques in space for structural elements of possible future large space structures. SCUBA divers are on hand to lend help to engineers if needed. The project is a joint effort carried out with NASA's Langley center.

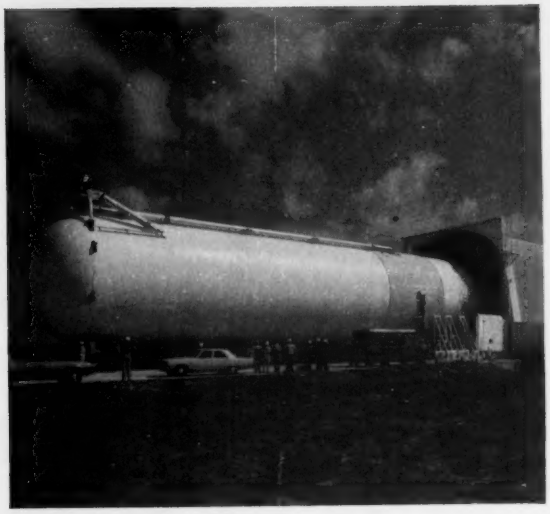
## Patents for Inventions from NASA Research

*The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.*

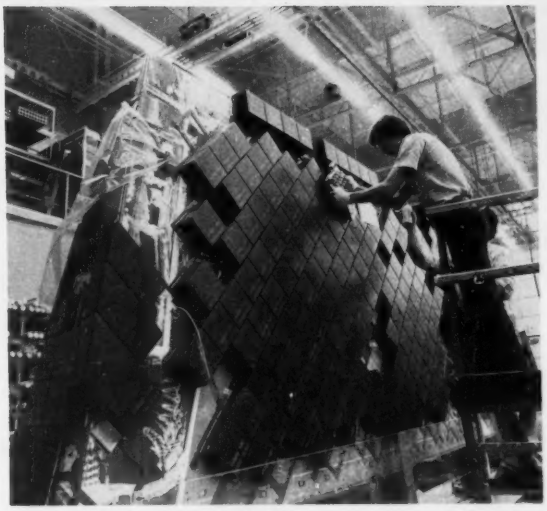
| Inventor(s) and Employer | Title | Patent No. | Installation |
|---|---|---|---|
| Robert P. Gruber, LeRC | Closed loop solar array-ion thruster system with power control circuitry | 4,143,314 | LeRC |
| William F. Hady, LeRC<br>Lawrence P. Ludwig | Shaft seal assembly for high speed and high pressure applications | 4,145,058 | LeRC |
| Julian G. Schiller, Univ. of Pittsburgh, Pa.<br>C.C. Liu | Method and device for the detection of phenol and related compounds | 4,145,255 | LeRC |
| Leland A. Imig, LaRC<br>William T. Davis<br>David C. Davis | Fatigue failure load indicator | 4,145,933 | LaRC |
| Joseph R. Dettling, United Tech Corp., Sunnyvale, Calif. | Retractable environmental seal | 4,146,180 | MSFC |
| Joseph R. Stephens, LeRC<br>Walter R. Witzke | A process for making a high toughness-high strength iron alloy | 4,146,409 | LeRC |

## Launches for 1979

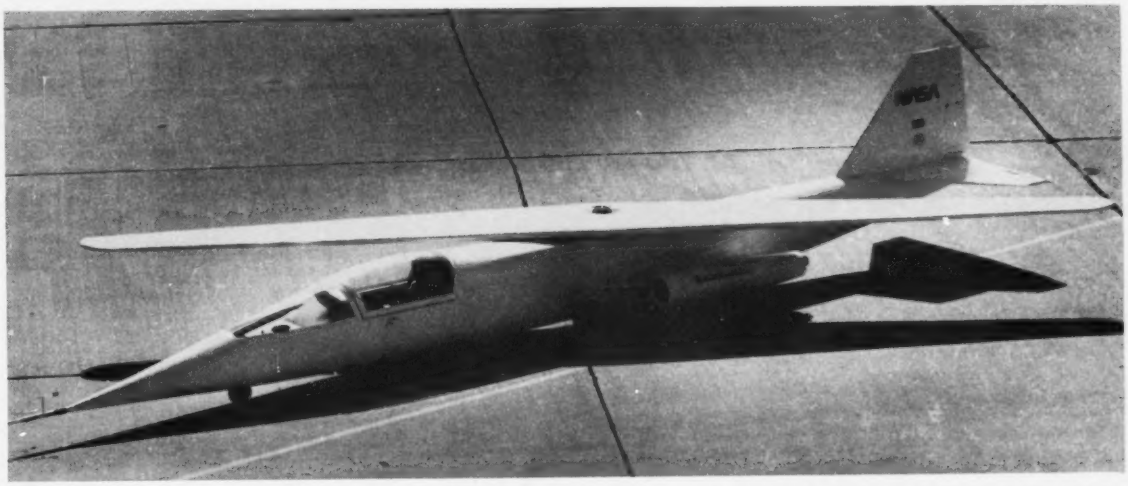
| Name | Launch Date | Vehicle | Range | Mission Remarks |
|---|---|---|---|---|
| SCATHA | Jan. 30 | Delta | ETR | DoD R&D. Spacecraft charging at high altitude Reimbursable. |
| SAGE-A | Feb. 18 | Scout | WFC | NASA applications satellite. Stratospheric aerosol and gas experiment. |
| Navy-20, C/U | April | Scout | WTR | DoD Transit. Reimbursable. |
| FLTSATCOM-B | May 3 | Atlas Centaur | ETR | DoD Navy communication satellite. Reimbursable. |
| NOAA-A | May 16 | Atlas-F | WTR | NOAA weather satellite. Reimbursable. |
| UK-6 | May 24 | Scout | WFC | UK scientific satellite. Reimbursable. |
| Westar-C, C/U | August | Delta | ETR | Western Union communications satellite. Reimbursable. |
| Intelsat V-A | August | Atlas Centaur | ETR | Intelsat communications satellite. Reimbursable. |
| HEAO-C | September | Atlas Centaur | ETR | Third high energy astronomical observatory to study highly energetic radiation from space. |
| MAGSAT-A | September | Scout | WTR | NASA applications satellite to study magnetic field. |
| Navy-21 | October | Scout | WTR | DoD transit satellite. Reimbursable. |
| SMM-A | October | Delta | ETR | NASA solar maximum mission satellite. |
| Space Shuttle | Nov. 9 | Space Shuttle | ETR | First manned Shuttle orbital flight. |
| RCA-C | December | Delta | ETR | Domestic communications satellite. Reimbursable. |



**External Tank Arrives**—The huge external tank, used at the Marshall center for the mated vertical ground vibration tests, arrived at the Kennedy center March 29 and was towed into the vehicle assembly building. The test article, which can hold 5½ million liters of super-cold liquid propellant, was carried to KSC on the Posiedon barge, once used to ferry Saturn V first and second stages to KSC from NASA's Michoud facility.



**Installing Shuttle's Protection "Blanket"**—Nearly 34,000 specially created tiles will protect NASA's Shuttle orbiter 102 (*Columbia*) from intense heat when it re-enters Earth's atmosphere from space. This picture shows the unique tiles being applied to the orbiter's body flap, which will be located on the aft portion of the vehicle. A Rockwell International worker is verifying structure-to-tile contour before the tiles are bonded. Under contract to Rockwell, Lockheed Missiles & Space Company is providing nearly 24,000 tiles. Rockwell is producing the other tiles from blocks provided by Lockheed.

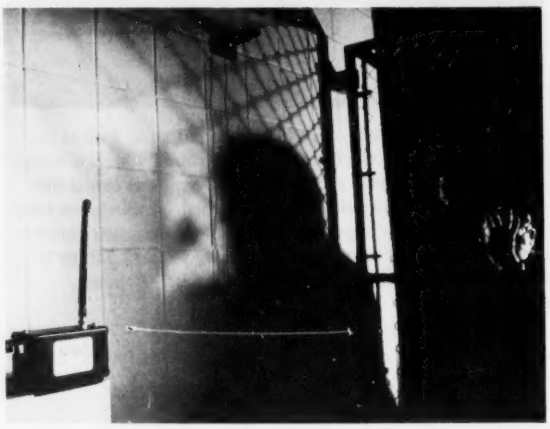


**Versatile Plane Ready for Testing**—The pivot-wing AD–1 aircraft has been delivered to the Dryden center, where it will be flown later this year. The small jet-powered aircraft will be flight tested to study the oblique wing concept, which is expected to increase fuel economy at higher speeds. At lower speeds the wing is oriented perpendicular to the fuselage. For high-speed operations, the wing is pivoted fore and aft to form oblique wing angles of up to 60 degrees. As the aircraft flies faster, pivoting the wing to an oblique angle decreases air drag, permitting increased speed and longer range for the same fuel expenditure.

# Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

## Intruder Detector



The shadowy prowler is attempting a break-in, unaware that his presence has already been detected and reported by the device in the lower left corner of the accompanying photo. It is part of a three-element Intruder Detection System developed by NASA's Ames Research Center from technology acquired in the Apollo lunar exploration program.

Apollo astronauts left behind on the Moon small portable seismic (shock) detectors to record subsurface vibrations and transmit to Earth data on the moon's density and thickness. A similar seismic detector is the key component of the Intruder Detection System.

Encased in a stainless steel tube, the detector is implanted in the ground outside the facility being protected—home, bank, industrial or other facilities. The vibration-sensing instrument picks up the footstep of anyone within a preset range. The detector is connected by cable to the transmitter, which relays the warning to a portable radio receiver. The radio alerts plant guards or home occupants by emitting an audible tone burst for each footstep.

For large industrial facilities, the detector's range can be as much as 80 meters. It would be set to shorter range for home use, so that the sensor would not pick up ordinary sidewalk traffic. When used in a plant or home, the system could be tied in to the alert station of a municipal or commercial protection agency. It also has applicability to wildlife research.

NASA has granted licenses to two manufacturers for commercial production of the system.

*For the benefit of all . . .*

NASA
National Aeronautics and Space Administration